

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)

Date of mailing
(day/month/year)

20. 01. 99

Applicant's or agent's file reference
HL55829/001

IMPORTANT NOTIFICATION

International application No.
PCT/GB97/03152

International filing date (day/month/year)
17/11/1997

Priority date (day/month/year)
16/11/1996

Applicant

MAYES, Eric, Leigh et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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PATENT COOPERATION TREATY



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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| | | | |
|---|--|--|--|
| Applicant's or agent's file reference HL55829/001 | FOR FURTHER ACTION | | See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416) |
| International application No. PCT/GB97/03152 | International filing date (day/month/year) 17/11/1997 | Priority date (day/month/year) 16/11/1996 | |
| International Patent Classification (IPC) or national classification and IPC G11B5/712 | | | |
| Applicant MAYES, Eric, Leigh et al. | | | |

| |
|---|
| <p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 3 sheets.</p> |
| <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input checked="" type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application |

| | |
|---|--|
| Date of submission of the demand 12/06/1998 | Date of completion of this report 20.01.99 |
| Name and mailing address of the IPEA/  European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465 | Authorized officer Mauger, J Telephone No. (+49-89) 2399-8447  |

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB97/03152

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-6,8-11 as originally filed

7 as received on 07/12/1998 with letter of 04/12/1998

Claims, No.:

1-10 with telefax of 08/01/1999

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

see separate sheet

4. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application.
☒ claims Nos. 6-10.

because:

- ☒ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

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see separate sheet

- ☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):
- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- ☐ no international search report has been established for the said claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | |
|-------------------------------|-----------------|
| Novelty (N) | Yes: Claims 1-5 |
| | No: Claims |
| Inventive step (IS) | Yes: Claims 1-5 |
| | No: Claims |
| Industrial applicability (IA) | Yes: Claims 1-5 |
| | No: Claims |

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

se separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB97/03152

Re Item I

Basis of the report

- 1) Claims 6-10 relate to a hard disc drive. The only mention of a hard disc drive in the application as filed, indicates that cobalt particles with a diameter of 8 nm have a blocking temperature which is within the range temperatures experienced within a hard disc drive (cf page 6, lines 10-17). This statement does not disclose a hard disc drive containing specific particles as defined in claims 6-10. Thus claims 6-10 are considered to contain subject-matter which extends beyond the disclosure of the application as originally filed, contrary to Article 34(2)(b) PCT.

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

- 1) Claims 6-10 contain subject-matter which extends beyond the disclosure of the application as originally filed. This objection applies to the whole content of these claims. Thus, the amendments cannot be disregarded in accordance with Rule 70.2(c) PCT and no opinion can be established for these claims.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 1) Reference is made to the following documents:

D1...US-A-5 574 961
D4...US-A-5 491 219
- 2) Document D1 discloses a process for preparing a magnetic device. Boron nitride and iron were co-sputtered onto a fused quartz substrate. The resulting layer consisted of single domain iron particles dispersed in a boron nitride matrix. The iron particles had a particle size of less than 100 nm. In figure 5 the coercive force for 30 nm particles is illustrated. The figure shows that these particles are ferromagnetic. Layers were formed with a variety of volume fractions of iron. The

resistivity of these films were measured (cf figure 4) and was shown to increase when the iron particles become isolated from one another. The initial point at which the iron particles become isolated will presumably correspond to a close spacing of the particles, i.e. between 2 and 10 nm. (see claims, column 3, line 51 to column 6, line 24 and column 7, lines 13-28).

The subject-matter of claims 1-5 is novel with respect to the disclosure of Document D1, because the claims require that the ferromagnetic particles are encased or partially encased in an organic macromolecule. Thus, claims 1-5 define novel subject-matter (Article 33(2) PCT).

- 3) The problem addressed by the present application is to enable magnetic media to be produced which exhibit the advantages associated with the use of particles having a size of less than 100 nm, but at the same time exhibit less media noise.

This problem is solved by encasing or partially encasing the particles in an organic macromolecule. The use of organic macromolecules rather than the boron nitride of D1 to encase the particles enables the particles size and separation to be more accurately controlled, which then reduces the media noise.

Encased ferromagnetic particles which may be used have been disclosed in the art (see D4). There is however no suggestion in either D1 or D4 that the properties of the particles disclosed in D4 would make them particularly appropriate for magnetic recording media.

An inventive step can therefore be recognised for the use of such particles in magnetic recording media as defined in claims 1-5 (Article 33(3) PCT).

Re Item VIII

Certain observations on the international application

- 1) The description on pages 3,5 and 6 indicates that an essential feature of the invention is that the particles are not superparamagnetic. The application however shows that one and the same particle will generally be both superparamagnetic and ferro- or ferrimagnetic depending on the temperature.

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The present definition of the claims merely states that the particles should have ferro or ferrimagnetic properties. Since however particles which are superparamagnetic will also be ferro or ferrimagnetic, the present definition does not clearly exclude superparamagnetic particles. Thus, the claims do not clearly define the essential features of the invention (Article 6 PCT).

Re Item VII

Certain defects in the international application

- 1) The description on page 7, line 19 contains an obvious error. The "oxidation methods" for making metal alloys referred to are clearly reducing agents. In line 22 of page 7 an original mention of "oxidation" has been changed to "reduction". In line 22, however the original application correctly referred to the production of ferrites by oxidation.
- 2) Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D4 is not mentioned in the description, nor are these documents identified therein.
- 3) The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

proximal arrangement.

One method of preparing a 2-D packed array of ferromagnetically ordered particles of uniform size up to 8 nm includes the removal of the ferrihydrite core from the native ferritin in aqueous solution, the incorporation of ferromagnetically ordered cobalt metal particles by sodium borohydride reduction of the aqueous Co(II) solution into the ferritin cavities, the generation of a narrow size distribution through ultracentrifugation, the injection of particles into an MES/glucose subphase solution upon which the 2-D array assembles, and the transfer of the 2-D array to a substrate which is then carbon coated. In this method, the ferritin source may be a vertebrate, invertebrate, plant, fungi, yeast, bacteria, or one produced through recombinant techniques.

In the method described, a metal alloy core may be produced by sodium borohydride reduction of a water soluble metal salt. Other oxidation methods include carbon, carbon monoxide, hydrogen, or hydrazine hydrate solution. Alternatively, a suitable solution may be oxidised to yield a metal ferrite core. Reduction may be chemical or electrochemical to yield the metal ferrite.

In this method, other methods of selecting a narrow size distribution may be employed such as short or long column meniscus depletion methods or magnetic field separation.

Further, in this method, divalent metal salts containing cadmium, calcium, or zinc may be added into the subphase solution to aid in particle ordering.

Further, in this, other methods of arranging the particles into a 2-D array may be employed, such as solution evaporation onto a solid substrate.

Further, in this method, the 2-D array may be coated with carbon-based films such as hydrogenated or

CLAIMS:

1. Use for data storage of a magnetic recording medium which includes a magnetizable layer, wherein said magnetizable layer comprises a plurality of
5 ferromagnetic particles each having a largest dimension no greater than 100nm, and each of which particles represents a separate ferromagnetic domain, and wherein, in the process for making the magnetic recording medium, the ferromagnetic particles are
10 encased, or partially encased, within an organic macromolecule.
2. Use according to claim 1, wherein the distance between adjacent ferromagnetic domains is at least 2nm.
3. Use according to claim 1 or 2, wherein the
15 distance between adjacent ferromagnetic domains is no greater than 10nm.
4. Use according to any preceding claim wherein, in the process for making the magnetic recording
20 medium, the ferromagnetic particles are encased, or partially encased, within the cavity or opening of a protein macromolecule.
5. Use according to claim 4, wherein, in the process for making the magnetic recording medium, the
25 ferromagnetic particles are encased within an apoferritin protein.
6. A hard disc drive comprising a magnetic recording medium which includes a magnetizable layer, wherein said magnetizable layer comprises a plurality
30 of ferromagnetic particles each having a largest dimension no greater than 100nm, and each of which particles represents a separate ferromagnetic domain, and wherein, in the process for making the magnetic recording medium, the ferromagnetic particles are
35 encased, or partially encased, within an organic macromolecule.

7. A hard disc drive according to claim 6,
wherein the distance between adjacent ferromagnetic
domains is at least 2nm.

8. A hard disc drive according to claim 6 or 7,
5 wherein the distance between adjacent ferromagnetic
domains is no greater than 10nm.

9. A hard disc drive according to claim 5, 7 or
8, wherein, in the process for making the magnetic
recording medium, the ferromagnetic particles are
10 encased, or partially encased, within the cavity or
opening of a protein macromolecule.

10. A hard disc drive according to claim 9,
wherein, in the process for making the magnetic
recording medium, the ferromagnetic particles are
15 encased within an apoferritin protein.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 97/03152

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G11B5/712 G11B5/62

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X A | US 5 574 961 A (EDELSTEIN ALAN S ET AL) 12 November 1996 see column 3, line 51 - line 60 see column 4, line 58 - line 64 see column 7, line 29 - line 46 see column 8, line 39 - line 55 | 1,2 3 |
| X A | EP 0 586 052 A (XEROX CORP) 9 March 1994 see column 16, line 56 - column 17, line 7 see claims 1-4 see column 17 | 8 1-7 |
| A | HONG J ET AL: "GRANULAR MAGNETIC COBALT METAL/POLYMER THIN FILM SYSTEM" IEEE TRANSACTIONS ON MAGNETICS, vol. 32, no. 5, September 1996, pages 4475-4477, XP000634042 see abstract | 1-8 |
| -/-- | | |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

14 January 1998

Date of mailing of the international search report

27/01/1998

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 97/03152

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|----------|--|-----------------------|
| A | US 5 491 219 A (MANN STEPHEN) 13 February 1996 see claims 1-11 | 1-7 |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 97/03152

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| US 5574961 A | 12-11-96 | NONE | |
| EP 0586052 A | 09-03-94 | US 5358659 A | 25-10-94 |
| | | DE 69310459 D | 12-06-97 |
| | | DE 69310459 T | 27-11-97 |
| | | JP 2648557 B | 03-09-97 |
| | | JP 6077037 A | 18-03-94 |
| | | US 5567564 A | 22-10-96 |
| | | US 5670078 A | 23-09-97 |
| US 5491219 A | 13-02-96 | NONE | |